Vernal Pool Tadpole Shrimp
(*Lepidurus packardi*)

Status

Federal: Endangered (59 Federal Register [FR] 48136, September 19, 1994)

State: None

Other: None

Recovery Plan: Vernal Pools of Northern California (under development)

Placer Legacy Category: Class 1

Distribution

California

Vernal pool tadpole shrimp (*Lepidurus packardi* Simon, 1886) is reported as endemic to the Central Valley of California (59 FR 48136, September 19, 1994; Helm 1998; Rogers 2001;). Rogers (2001) determined that specimens from southern Oregon and the California Great Basin that were originally described as *L. packardi* were, in fact, *Lepidurus cryptus*, a recently described species of tadpole shrimp.

The historical range of vernal pool tadpole shrimp in California includes annual grasslands of the Great Central Valley. Today the species ranges from Shasta County in the north to Merced County in the south, with one disjunct population occurring in western Alameda County (Rogers 2001).

Vernal pool tadpole shrimp have been reported from the following California Vernal Pool Regions: Northwest Sacramento, Northeast Sacramento, Southeast Sacramento, Solano, San Joaquin, and South Sierra Foothill (California Department of Fish and Game 1998). The California Natural Diversity Database (CNDDB) (2002) lists 160 occurrences of vernal pool tadpole fairy shrimp in California.

Placer County Phase I Planning Area

Historical

The historical distribution of vernal pool tadpole shrimp can only be inferred from the historical distribution of its habitat. Annual grasslands of western Placer County, particularly within the Great Valley ecoregion, probably supported a patchy distribution of vernal pool tadpole shrimp (Rogers pers. comm.).

Current

There are two known populations of vernal pool tadpole shrimp in western Placer County. The first is located on the U.S. Air Force Lincoln Communications Facility where, in 1996, at least five vernal pools of a 236-pool complex were observed to support vernal pool tadpole shrimp (36 pools were surveyed). The second is on the Woodcreek Oaks Mitigation Site between Kasenburg Creek and the south branch of Pleasant Grove Creek; vernal pool tadpole shrimp adults were observed in one pool on this site in 1995.

An additional population was observed in 1993 west of the Phase I Planning Area, in Sutter County, California (California Natural Diversity Database 2002).

Population Status & Trends

California

As of January 2002, the CNDDB listed 160 occurrences of vernal pool tadpole shrimp in California. Although vernal pool tadpole shrimp is widely distributed in California, it is now locally uncommon throughout the historical range (Helm 1998; Eriksen and Belk 1999).

Placer County Phase I Planning Area

As of January 2002, the CNDDB listed two occurrences of vernal pool tadpole shrimp within the Phase I Planning Area. Several nature preserves and mitigation banks have been established in the Phase I Planning Area with the partial goal of preserving habitat for vernal pool tadpole shrimp. These preservation areas include Wildlands, Inc.'s, Aitken Ranch Mitigation Bank, Wildlands Mitigation Bank, and Orchard Creek Preservation Area; Eastridge Southern Wetland Preserve; Sterling Pacific Assets' Lincoln Crossing Mitigation Site; and the City of Roseville's Woodcreek Compensation Area (Jones & Stokes file data, California Natural Diversity Database 2002).

Natural History

Habitat Requirements

Vernal pool tadpole shrimp occur in a variety of natural and artificial seasonally inundated habitats. They require seasonally aquatic habitats that are wet for at least 7 weeks and dry in summer (Gallagher 1996). Helm (1998) observed vernal pool tadpole shrimp occurring in vernal pools (natural, artificial, and constructed), seasonal wetlands (natural and artificial), alkaline pools, clay flats, vernal swales, stockponds, railroad right-of-way pools, roadside ditches, and road rut pools resulting from vehicular activity. Occupied pools and wetlands typically have highly turbid waters or aquatic vegetation that may provide shelter from predators (59 FR 48136, September 19, 1994; Stone pers. comm.).

Reproduction

Vernal pool tadpole shrimp are bisexual. Diapausing cysts (eggs) occurring in the dry pool bottom hatch within 3 weeks of inundation (Ahl 1991). The hatched neonate is a metanauplius that undergoes several molts, each gaining additional phyllopod appendages until reaching sexual maturity. This process takes approximately 6–7 weeks depending on temperature and food availability (Ahl 1991; Gallagher 1996; Helm 1998). Reproduction occurs throughout the ponding season, when females average 10–12 millimeters (0.39–0.47 inch) in carapace length (Ahl 1991). Laboratory studies conducted by Ahl (1991) revealed that eggs can hatch during the same ponding event in which they were laid without intervening dehydration. The remaining unhatched cysts settle to the pool substrate and contribute to the cyst bank for subsequent wet seasons.

Dispersal Patterns

Vernal pool tadpole shrimp disperse locally during extremely wet years when individual pools in a complex spill into or are connected with adjacent pools. Long-distance dispersal can result from cysts being carried on the wind and on the bodies or in the guts of larger animals. Cysts, including those still in brood sacs, can pass undamaged and undigested through the digestive tracts of birds (Proctor et al. 1967 cited in Eriksen and Belk 1999); subsequent deposition of fecal matter can result in the inoculation of a new site. Cysts trapped in mud can adhere to the feet and feathers of waterfowl and the hooves and fur of

grazing mammals and be transported to the dried mud of different vernal pool complexes (Eriksen and Belk 1999). Cysts may also be transported between pools in the digestive tracts of amphibian predators such as frogs and salamanders (Rogers pers. comm.).

Longevity

Vernal pool tadpole shrimp is considered a long-lived species. Adults are often present and reproductive until the pools dry up in the spring (59 FR 48136, September 19, 1994).

Sources of Mortality

The greatest sources of mortality to vernal pool tadpole shrimp are predation and desiccation. Tadpole shrimp are left exposed when their habitat dries up. In addition, both adult shrimp and diapausing cysts can be crushed by foot traffic and off-highway vehicles (Hathaway 1996).

Movement and Migratory Patterns

The presence of vernal pool tadpole shrimp adults coincides with the filling and drying pattern of the vernal pool habitats. Populations of adults are typically present from December through early April. Resting cysts are always present in an occupied pool basin.

Behavior

Vernal pool tadpole shrimp are filter feeders and opportunistic predators on aquatic insect larvae, segmented worms (Oligochaeta), water fleas (Cladocera), seed shrimp (Ostracoda), copepods (Copepoda), fairy shrimp (Anostraca), and other vernal pool tadpole shrimp. This species hunts by moving along the pool bottom or aquatic vegetation, stirring up the muddy substrate, and capturing prey items with its phyllopods to direct them into the feeding groove or mouth (Rogers pers. comm.). This feeding behavior and predator avoidance leads to vernal pool tadpole shrimp being most often observed at the pool bottom.

Ecological Relationships

Vernal pool tadpole shrimp are preyed on by migratory waterfowl, amphibians, predatory diving beetles (Coleoptera:Dytiscidae), water boatmen (Hemiptera:Corixidae), and other vernal pool tadpole shrimp. Large freshwater branchiopods in California serve as an important source of protein and energy for migratory waterfowl (Eriksen and Belk 1999). Many vernal pools occur along the Pacific flyway; the use of these pools as resting and feeding grounds by migratory birds is well documented (Silveria 1998; Sterling pers. comm.).

Vernal pool tadpole shrimp commonly co-occur with vernal pool fairy shrimp (*Branchinecta lynchi*), Conservancy fairy shrimp (*Branchinecta conservatio*), and California linderiella (*Linderiella occidentalis*) (Helm 1998; Stone pers. comm.).

Population Threats

The greatest threats to the persistence of vernal pool tadpole shrimp are habitat loss and degradation resulting from urban development and agriculture. Vernal pools occur in large, flat, open grasslands that are ideal for a number of economic uses including airports, military bases, rice and grain fields, cattle grazing, aggregate mining, and urban development.

References

Printed References

Ahl, J. S. B. 1991. Factors affecting contributions of the tadpole shrimp, (*Lepiduris packardi*), to its oversummering egg reserves. *Hydrobiologia* 212:137–43.

California Natural Diversity Database. 2002. RareFind 2, Version 2.1.2 (September 2002 update). Sacramento, CA: California Department of Fish and Game.

Eriksen, C. H., and D. Belk. 1999. *Fairy shrimps of California's puddles, pools, and playas*. Eureka, CA: Mad River Press.

California Department of Fish and Game. 1998. California vernal pool assessment, preliminary report. May. Available: http://maphost.dfg.ca.gov/wetlands/vp_asses_rept/index.htm. Accessed: January 15, 2003.

Gallagher, S. P. 1996. Seasonal occurrence and habitat characteristics of some vernal pool branchiopoda in northern California, USA. *Journal of Crustacean Biology* 16(2):323–329.

Hathaway, S. A., D. P. Sheehan, and M. A. Simovich. 1996. Vulnerability of branchiopod cysts to crushing. *Journal of Crustacean Biology*. 16(3):448–452.

Helm, B. 1998. The biogeography of eight large branchiopods endemic to California. Pages 124–139 in C. W. Witham, E. Bauder, D. Belk, W. Ferren, and R. Ornduff (eds.), *Ecology, conservation, and management of vernal pool ecosystems – proceedings from a 1996 conference*. Sacramento, CA: California Native Plant Society.

Rogers, D.C. 2001. Revision of the neartic *Lepidurus* (Notostraca). *Journal of Crustacean Biology* 21(4): 991–1006.

Silveria, J. G. 1998. Avian uses of vernal pools and implications for conservation practice. Pages 92–106 in C. W. Witham, E. Bauder, D. Belk, W. Ferren, and R. Ornduff (eds.), *Ecology, conservation, and management of vernal pool ecosystems – proceedings from a 1996 conference*. Sacramento, CA: California Native Plant Society.

Personal Communications

Rogers, D. Christopher. Personal communication. December, 2002.

Sterling, John. Wildlife Biologist. Jones & Stokes. January 2003 – meeting.

Stone, Patrick. Invertebrate Ecologist. Jones & Stokes. 1999–2002. Field surveys.